

LP156WH2
Liquid Crystal Display

Product Specification

SPECIFICATION
FOR
APPROVAL

(◆) Preliminary Specification

() Final Specification

| | |
|-------|------------------|
| Title | 15.6" HD TFT LCD |
|-------|------------------|

| | |
|----------|------|
| Customer | Asus |
| MODEL | |

| | |
|----------|----------------------|
| SUPPLIER | LG Display Co., Ltd. |
| *MODEL | LP156WH2 |
| Suffix | TLF1 |

*When you obtain standard approval,
please use the above model name without suffix

| APPROVED BY | SIGNATURE |
|-------------|-----------|
| / | |
| / | |
| / | |

Please return 1 copy for your confirmation with your signature and comments.

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LG Display Co., Ltd

LP156WH2
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RECORD OF REVISIONS

[illegible]

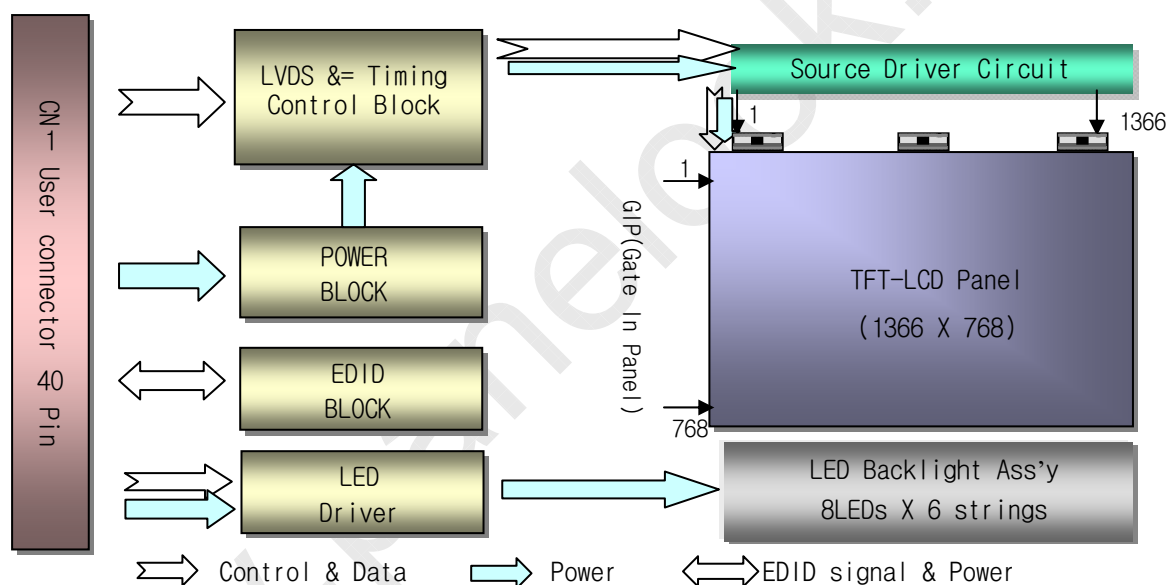
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1. General Description

The LP156WH2 is a Color Active Matrix Liquid Crystal Display with an integral Light Emitting Diode (LED) backlight system. The matrix employs a-Si Thin Film Transistor as the active element. It is a transmissive type display operating in the normally white mode. This TFT-LCD has 15.6 inches diagonally measured active display area with HD resolution (768 vertical by 1366 horizontal pixel array). Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 6-bit gray scale signal for each dot, thus, presenting a palette of more than 262,144 colors.

The LP156WH2 has been designed to apply the interface method that enables low power, high speed, low EMI.

The LP156WH2 is intended to support applications where thin thickness, low power are critical factors and graphic displays are important. In combination with the vertical arrangement of the sub-pixels, the LP156WH2 characteristics provide an excellent flat display for office automation products such as Notebook PC.



General Features

| | |
|------------------------|---|
| Active Screen Size | 15.6 inches diagonal |
| Outline Dimension | 359.3(H, typ) × 209.5(V, typ) × 5.5(D,max) [mm] |
| Pixel Pitch | 0.252mm × 0.252 mm |
| Pixel Format | 1366 horiz. By 768 vert. Pixels RGB strip arrangement |
| Color Depth | 6-bit, 262,144 colors |
| Luminance, White | 220 cd/m ² (Typ.5 point) |
| Power Consumption | Total 5.55 Watt(Typ.) @ LCM circuit 1.55 Watt(Typ.), B/L input 4.0 Watt(Typ.) |
| Weight | 450g (Max.) |
| Display Operating Mode | Transmissive mode, normally white |
| Surface Treatment | Anti-Glare treatment of the front polarizer |
| RoHS Comply | Yes |

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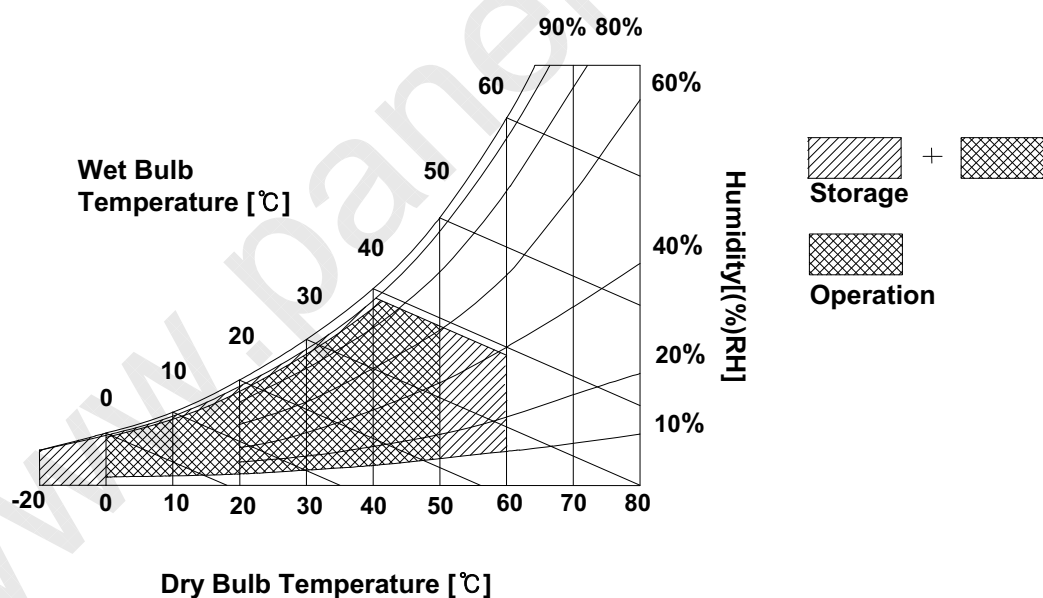
2. Absolute Maximum Ratings

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

Table 1. ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | Values | | Units | Notes |
|----------------------------|--------|--------|-----|-------|-------------|
| | | Min | Max | | |
| Power Input Voltage | VCC | -0.3 | 4.0 | Vdc | at 25 ± 5°C |
| Operating Temperature | TOP | 0 | 50 | °C | 1 |
| Storage Temperature | HST | -20 | 60 | °C | 1 |
| Operating Ambient Humidity | HOP | 10 | 90 | %RH | 1 |
| Storage Humidity | HST | 10 | 90 | %RH | 1 |

Note : 1. Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be 39°C Max, and no condensation of water.





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3. Electrical Specifications

3-1. Electrical Characteristics

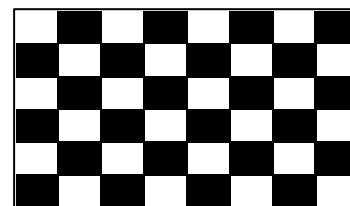
The LP156WH2 requires two power inputs. The first logic is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second backlight is the input about LED BL.with LED Driver.

Table 2. ELECTRICAL CHARACTERISTICS

| Parameter | Symbol | Values | | | Unit | Notes |
|--------------------------------|-----------------------|--------|------|-------|------|-------|
| | | Min | Typ | Max | | |
| LOGIC : | | | | | | |
| Power Supply Input Voltage | V _{CC} | 3.0 | 3.3 | 3.6 | V | |
| Power Supply Input Current | I _{CC} | - | 470 | 540 | mA | 1 |
| Power Consumption | P _{CC} | - | 1.55 | 1.78 | W | 1 |
| Power Supply Inrush Current | I _{CC_P} | - | - | 1500 | mA | |
| LVDS Impedance | Z _{LVDS} | 90 | 100 | 110 | Ω | 2 |
| BACKLIGHT : (with LED Driver) | | | | | | |
| LED Power Input Voltage | V _{LED} | 7.0 | 12.0 | 20.0 | V | |
| LED Power Input Current | I _{LED} | - | 330 | - | mA | 3 |
| LED Power Consumption | P _{LED} | - | 4.0 | - | W | 3 |
| LED Power Inrush Current | I _{LED_P} | - | - | - | mA | |
| PWM Dimming (Duty) Ratio | - | 5 | - | 100 | % | 4 |
| PWM Impedance | Z _{PWM} | 20 | 40 | 60 | kΩ | |
| PWM Frequency | F _{PWM} | 200 | - | 10000 | Hz | 5 |
| PWM High Level Voltage | V _{PWM_H} | 3.0 | - | 5.3 | V | |
| PWM Low Level Voltage | V _{PWM_L} | 0 | - | 0.5 | V | |
| LED_EN High Voltage | V _{LED_EN_H} | 3.0 | - | 5.3 | V | |
| LED_EN Low Voltage | V _{LED_EN_L} | 0 | - | 0.5 | V | |
| Life Time | | 15,000 | - | - | Hrs | 6 |

Note)

1. The specified I_{CC} current and power consumption are under the V_{CC} = 3.3V , 25℃ , f_v = 60Hz condition whereas Mosaic pattern is displayed and f_v is the frame frequency.



2. This impedance value is needed to proper display and measured form LVDS Tx to the mating connector.
3. The specified LED current and power consumption are under the V_{LED} = 12.0V , 25℃ , Dimming of Max luminance whereas White pattern is displayed and f_v is the frame frequency.
4. The operation of LED Driver below minimum dimming ratio may cause flickering or reliability issue.
5. This Spec. is not effective at 100% dimming ratio as an exception because it has DC level equivalent to 0Hz. In spite of acceptable range as defined, the PWM Frequency should be fixed and stable for more consistent brightness control at any specific level desired.
6. The life time is determined as the time at which brightness of LED is 50% compare to that of initial value at the typical LED current. These LED backlight has 6 strings on it and the typical current of LED's string is base on 21mA.



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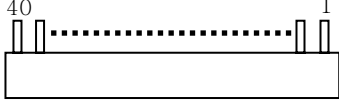
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3-2. Interface Connections

This LCD employs one interface connections, a 40 pin connector is used for the module electronics interface and LED Driver.

The electronics interface connector is a model 20455-040E-0x manufactured by I-PEX.

Table 3. MODULE CONNECTOR PIN CONFIGURATION (CN1)

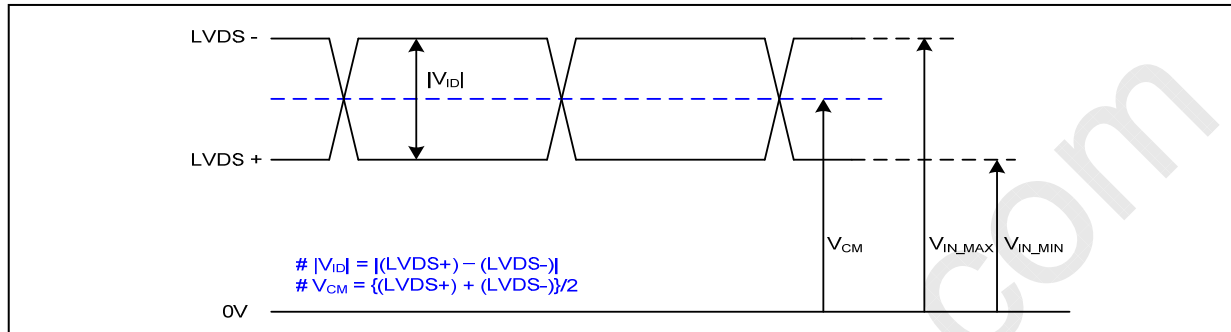
| Pin | Symbol | Description | Notes |
|-----|------------------------|--|---|
| 1 | NC | No connection | <p>1, Interface chips</p> <p>1.1 LCD : SW, SW0624 (LCD Controller) including LVDS Receiver</p> <p>1.2 System : THC63LVDF823A or equivalent</p> <p>* Pin to Pin compatible with LVDS</p> <p>2. Connector</p> <p>2.1 LCD : 20455-040E-0x, I-PEX ISO50-L40B-C10, UJU GT05Q-40S-H10, LSM</p> <p>2.2 Mating : 20453-040T-0x, I-PEX or equivalent.</p> <p>2.3 Connector pin arrangement</p>  <p>[LCD Module Rear View]</p> |
| 2 | VCC | Power Supply, 3.3V Typ. | |
| 3 | VCC | Power Supply, 3.3V Typ. | |
| 4 | V EEDID | DDC 3.3V power | |
| 5 | NC | No Connection | |
| 6 | Clk EEDID | DDC Clock | |
| 7 | DATA EEDID | DDC Data | |
| 8 | Odd_R _{IN} 0- | Negative LVDS differential data input | |
| 9 | Odd_R _{IN} 0+ | Positive LVDS differential data input | |
| 10 | GND | Ground | |
| 11 | Odd_R _{IN} 1- | Negative LVDS differential data input | |
| 12 | Odd_R _{IN} 1+ | Positive LVDS differential data input | |
| 13 | GND | Ground | |
| 14 | Odd_R _{IN} 2- | Negative LVDS differential data input | |
| 15 | Odd_R _{IN} 2+ | Positive LVDS differential data input | |
| 16 | GND | Ground | |
| 17 | Odd_CLKIN- | Negative LVDS differential clock input | |
| 18 | Odd_CLKIN+ | Positive LVDS differential clock input | |
| 19 | GND | Ground | |
| 20 | NC | No Connection | |
| 21 | NC | No Connection | |
| 22 | GND | Ground | |
| 23 | NC | No Connection | |
| 24 | NC | No Connection | |
| 25 | GND | Ground | |
| 26 | NC | No Connection | |
| 27 | NC | No Connection | |
| 28 | GND | Ground | |
| 29 | NC | No Connection | |
| 30 | NC | No Connection | |
| 31 | VLED_GND | LED Ground | |
| 32 | VLED_GND | LED Ground | |
| 33 | VLED_GND | LED Ground | |
| 34 | NC | No Connection | |
| 35 | BLIM | PWM for Luminance control | |
| 36 | BL_On | Backlight On/Off Control | |
| 37 | NC | No Connection | |
| 38 | VLED | LED Power Supply (7V-20V) | |
| 39 | VLED | LED Power Supply (7V-20V) | |
| 40 | VLED | LED Power Supply (7V-20V) | |

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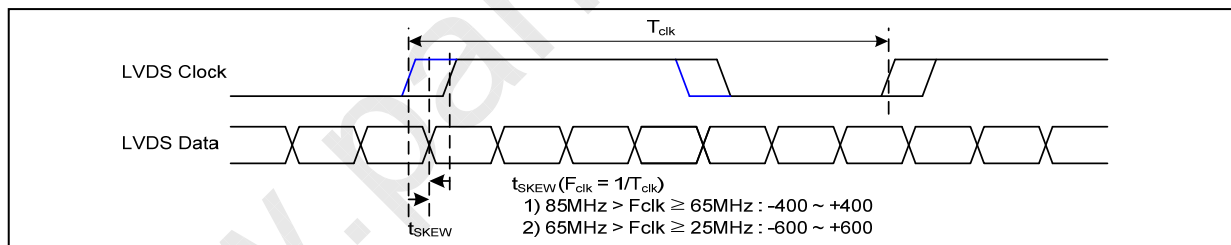
3-3. LVDS Signal Timing Specifications

3-3-1. DC Specification



| Description | Symbol | Min | Max | Unit | Notes |
|---------------------------|------------|-----|-----|------|-------|
| LVDS Differential Voltage | $ V_{ID} $ | 100 | 600 | mV | - |
| LVDS Common mode Voltage | V_{CM} | 0.6 | 1.8 | V | - |
| LVDS Input Voltage Range | V_{IN} | 0.3 | 2.1 | V | - |

3-3-2. AC Specification

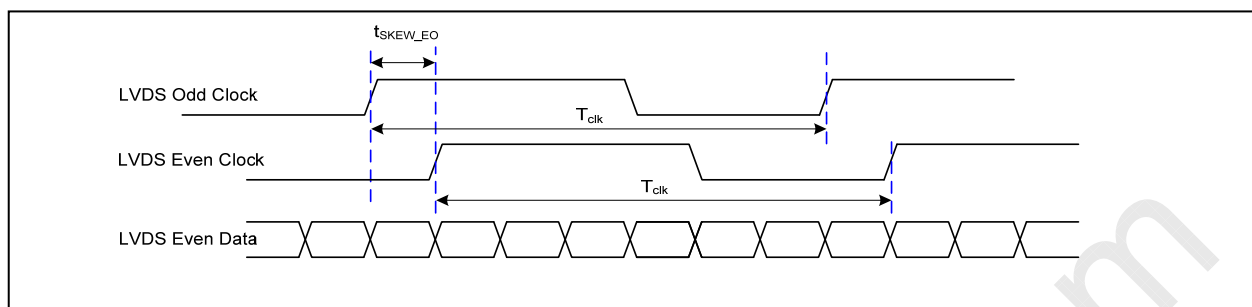


| Description | Symbol | Min | Max | Unit | Notes |
|--|----------------|-------|---------|-----------|------------------------------|
| LVDS Clock to Data Skew Margin | t_{SKEW} | - 400 | + 400 | ps | $85MHz > F_{clk} \geq 65MHz$ |
| | t_{SKEW} | - 600 | + 600 | ps | $65MHz > F_{clk} \geq 25MHz$ |
| LVDS Clock to Clock Skew Margin (Even to Odd) | t_{SKEW_EO} | - 1/7 | + 1/7 | T_{clk} | - |
| Maximum deviation of input clock frequency during SSC | F_{DEV} | - | ± 3 | % | - |
| Maximum modulation frequency of input clock during SSC | F_{MOD} | - | 200 | KHz | - |

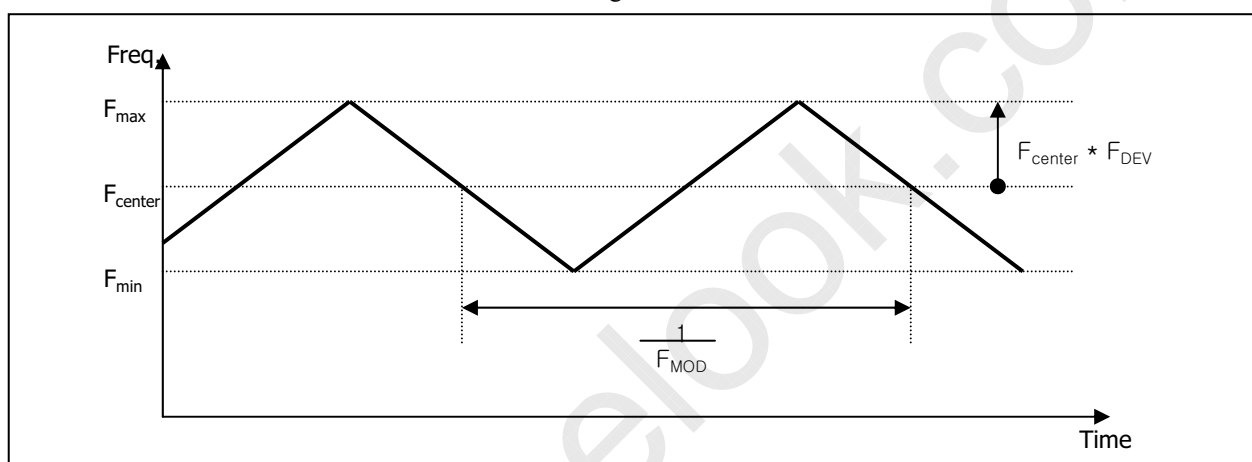


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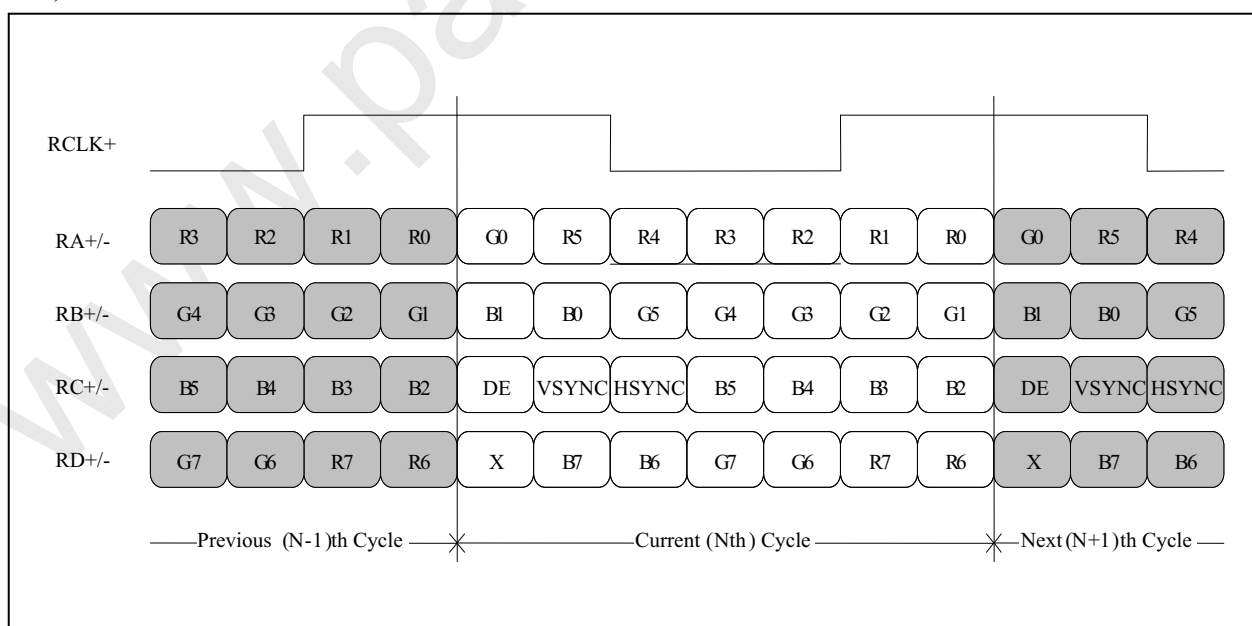
< Clock skew margin between channel >



< Spread Spectrum >

3-3-3. Data Format

1) LVDS 1 Port



< LVDS Data Format >



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3-4. Signal Timing Specifications

This is the signal timing required at the input of the User connector. All of the interface signal timing should be satisfied with the following specifications and specifications of LVDS Tx/Rx for its proper operation.

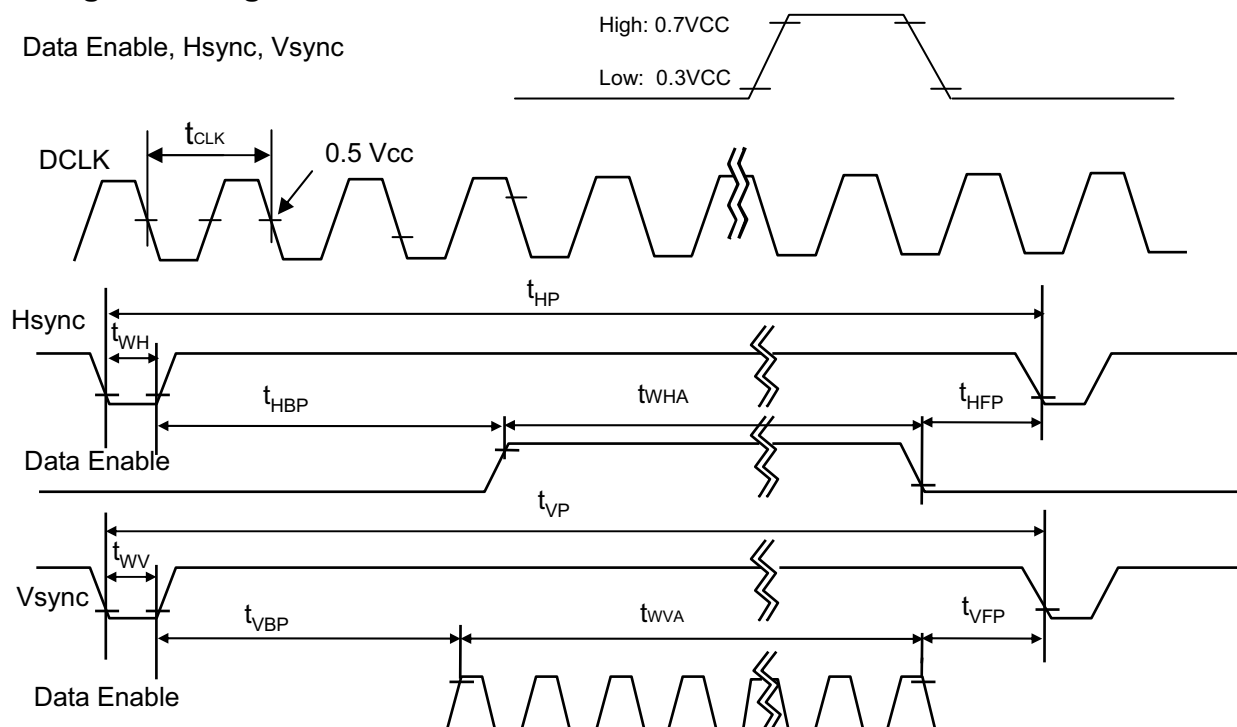
Table 6. TIMING TABLE

| ITEM | Symbol | Min | Typ | Max | Unit | Note |
|-------------|------------------------|-----------|------|------|------|------|
| DCLK | Frequency | f_{CLK} | - | 72.3 | - | MHz |
| Hsync | Period | t_{HP} | 1470 | 1526 | 1586 | tCLK |
| | Width | t_{WH} | 23 | 32 | 40 | |
| | Width-Active | t_{WHA} | 1366 | 1366 | 1366 | |
| Vsync | Period | t_{VP} | 779 | 790 | 801 | tHP |
| | Width | t_{WV} | 2 | 5 | 8 | |
| | Width-Active | t_{WVA} | 768 | 768 | 768 | |
| Data Enable | Horizontal back porch | t_{HBP} | 72 | 80 | 124 | tCLK |
| | Horizontal front porch | t_{HFP} | 8 | 48 | 48 | |
| | Vertical back porch | t_{VBP} | 8 | 14 | 20 | tHP |
| | Vertical front porch | t_{VFP} | 1 | 3 | 5 | |

3-5. Signal Timing Waveforms

Condition : VCC = 3.3V

Data Enable, Hsync, Vsync



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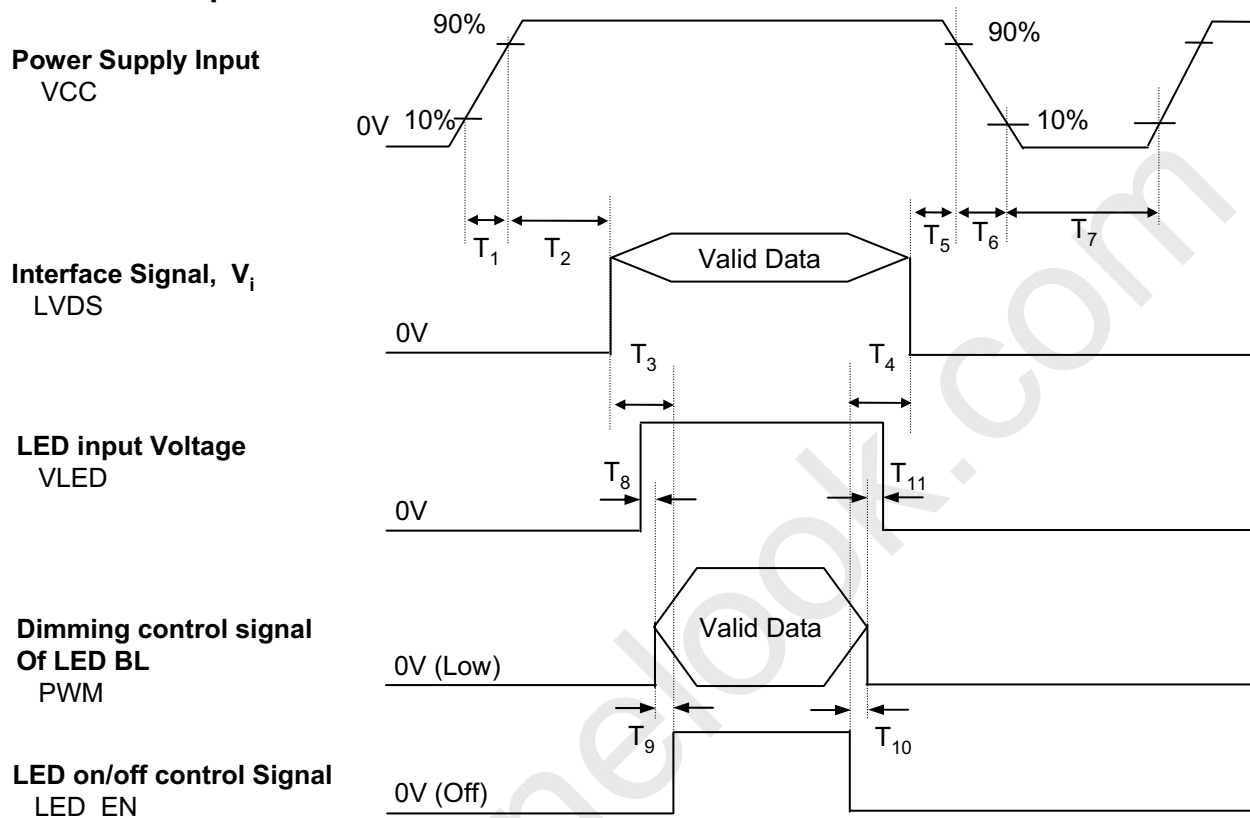
3-6. Color Input Data Reference

The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color ; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

Table 7. COLOR DATA REFERENCE

| Color | | Input Color Data | | | | | | | | | | | | | | | | | |
|-------------|------------|------------------|-----|-----|-----|-----|-----|-------|-----|-----|-----|-----|-----|------|-----|-----|-----|-----|-----|
| | | RED | | | | | | GREEN | | | | | | BLUE | | | | | |
| | | MSB | | | LSB | | | MSB | | | LSB | | | MSB | | | LSB | | |
| | | R 5 | R 4 | R 3 | R 2 | R 1 | R 0 | G 5 | G 4 | G 3 | G 2 | G 1 | G 0 | B 5 | B 4 | B 3 | B 2 | B 1 | B 0 |
| Basic Color | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| RED | RED (00) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | RED (01) | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ... | | | | | | | | | | | | | | | | | | |
| | RED (62) | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | RED (63) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| GREEN | GREEN (00) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | GREEN (01) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ... | | | | | | | | | | | | | | | | | | |
| | GREEN (62) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | GREEN (63) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| BLUE | BLUE (00) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | BLUE (01) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | ... | | | | | | | | | | | | | | | | | | |
| | BLUE (62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | BLUE (63) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |

3-7. Power Sequence


Table 6. POWER SEQUENCE TABLE

| Parameter | Value | | | Units |
|-----------------|-------|------|------|-------|
| | Min. | Typ. | Max. | |
| T ₁ | 0.5 | - | 10 | ms |
| T ₂ | 0 | - | 50 | ms |
| T ₃ | 200 | - | - | ms |
| T ₄ | 200 | - | - | ms |
| T ₅ | 0 | - | 50 | ms |
| T ₆ | 3 | - | 10 | ms |
| T ₇ | 400 | - | - | ms |
| T ₈ | 50 | - | 100 | ms |
| T ₉ | 0 | - | 100 | ms |
| T ₁₀ | 0 | - | 100 | ms |
| T ₁₁ | 50 | - | 100 | ms |

Note)

1. Valid Data is Data to meet "3-3. LVDS Signal Timing Specifications"
2. Please avoid floating state of interface signal at invalid period.
3. When the interface signal is invalid, be sure to pull down the power supply for LCD VCC to 0V.
4. LED power must be turn on after power supply for LCD and interface signal are valid.

4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25°C. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of Φ and Θ equal to 0°.

FIG. 1 presents additional information concerning the measurement equipment and method.

FIG. 1 Optical Characteristic Measurement Equipment and Method

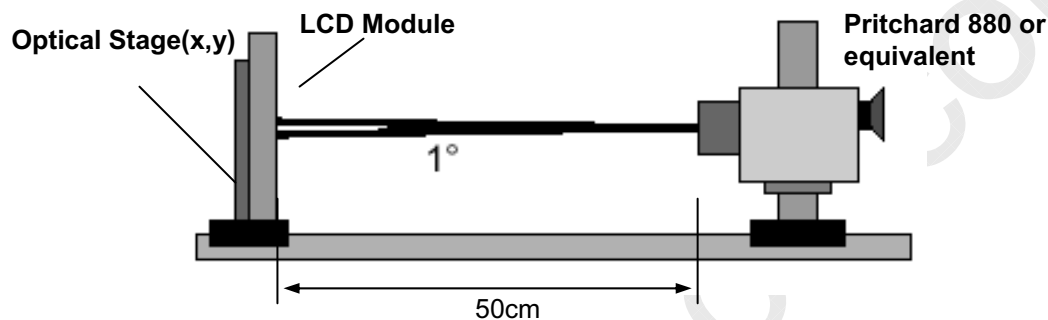


Table 9. OPTICAL CHARACTERISTICS

$T_a=25^{\circ}\text{C}$, $V_{CC}=3.3\text{V}$, $f_v=60\text{Hz}$, $f_{CLK}=72.3\text{MHz}$, $I_{LED}=21\text{mA}$

| Parameter | Symbol | Values | | | Units | Notes |
|-------------------------------------|------------------|--------|-------|-------|-------------------|-------|
| | | Min | Typ | Max | | |
| Contrast Ratio | CR | 300 | 400 | - | | 1 |
| Surface Luminance, white | L_{WH} | 190 | 220 | - | cd/m ² | 2 |
| Luminance Variation | δ_{WHITE} | - | 1.4 | 1.6 | | 3 |
| Response Time | $Tr_R + Tr_D$ | - | 8 | 15 | ms | 4 |
| Color Coordinates | | | | | | |
| RED | RX | 0.593 | 0.623 | 0.653 | | |
| | RY | 0.320 | 0.350 | 0.380 | | |
| GREEN | GX | 0.300 | 0.330 | 0.360 | | |
| | GY | 0.559 | 0.589 | 0.619 | | |
| BLUE | BX | 0.120 | 0.150 | 0.180 | | |
| | BY | 0.059 | 0.089 | 0.119 | | |
| WHITE | WX | 0.283 | 0.313 | 0.343 | | |
| | WY | 0.299 | 0.329 | 0.359 | | |
| Viewing Angle | | | | | | |
| x axis, right ($\Phi=0^{\circ}$) | Θ_r | 40 | - | - | degree | 5 |
| x axis, left ($\Phi=180^{\circ}$) | Θ_l | 40 | - | - | degree | |
| y axis, up ($\Phi=90^{\circ}$) | Θ_u | 10 | - | - | degree | |
| y axis, down ($\Phi=270^{\circ}$) | Θ_d | 30 | - | - | degree | |
| Color Gamut | % | - | 60 | - | | 6 |
| Gray Scale | | | | | | |

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Note)

1. Contrast Ratio(CR) is defined mathematically as

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

2. Surface luminance is the average of 5 point across the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG 1.

$$L_{WH} = \text{Average}(L_1, L_2, \dots L_5)$$

3. The variation in surface luminance, The panel total variation (δ_{WHITE}) is determined by measuring L_N at each test position 1 through 13 and then defined as followed numerical formula.
For more information see FIG 2.

$$\delta_{WHITE} = \frac{\text{Maximum}(L_1, L_2, \dots L_{13})}{\text{Minimum}(L_1, L_2, \dots L_{13})}$$

4. Response time is the time required for the display to transition from white to black (rise time, Tr_R) and from black to white(Decay Time, Tr_D). For additional information see FIG 3.

5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 4.

6. Gray scale specification

* $f_V = 60\text{Hz}$

| Gray Level | Luminance [%] (Typ) |
|------------|---------------------|
| L0 | 0.16 |
| L7 | 1.5 |
| L15 | 5.4 |
| L23 | 12.2 |
| L31 | 21.0 |
| L39 | 34.8 |
| L47 | 52.5 |
| L55 | 74.2 |
| L63 | 100 |



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FIG. 2 Luminance

<Measuring point for Average Luminance & measuring point for Luminance variation>

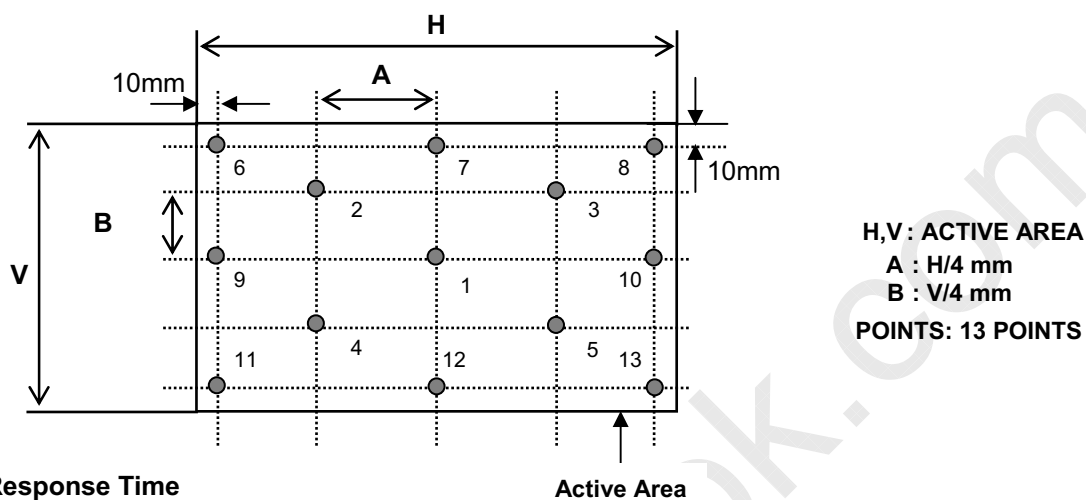


FIG. 3 Response Time

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".

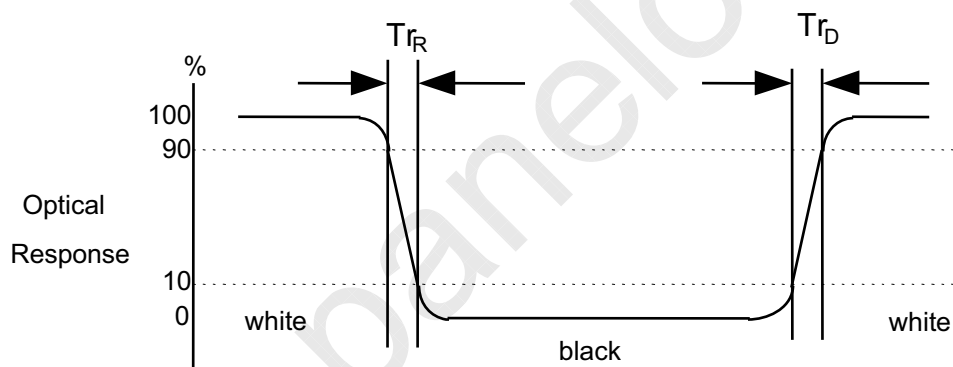
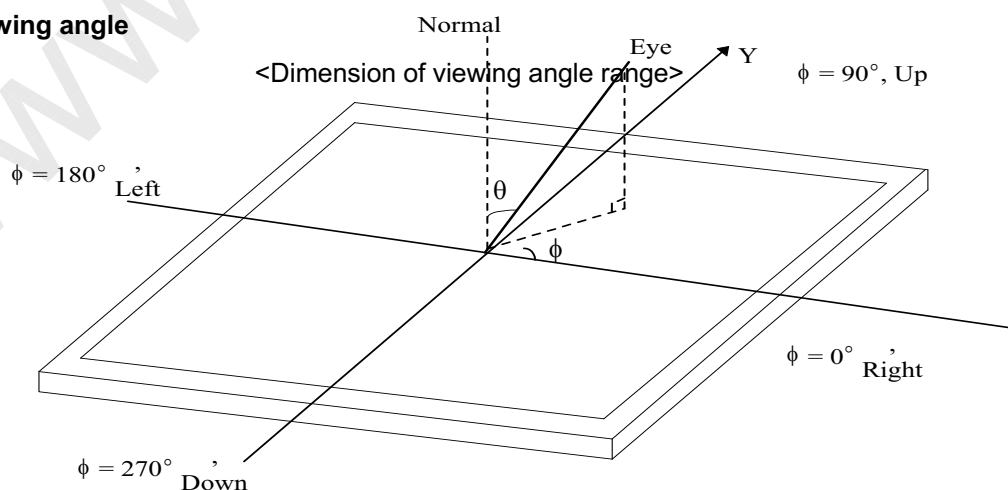


FIG. 4 Viewing angle



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5. Mechanical Characteristics

The contents provide general mechanical characteristics for the model LP156WH2. In addition the figures in the next page are detailed mechanical drawing of the LCD.

| | | |
|---------------------|--|---------------|
| Outline Dimension | Horizontal | 359.3 ± 0.5mm |
| | Vertical | 209.5 ± 0.5mm |
| | Thickness | 5.5mm (max) |
| Bezel Area | Horizontal | 349.8 ± 0.5mm |
| | Vertical | 197.1 ± 0.5mm |
| Active Display Area | Horizontal | 344.232 mm |
| | Vertical | 193.536 mm |
| Weight | 450g (Max.) | |
| Surface Treatment | Hard Coating(3H), Glare treatment of the front polarizer | |

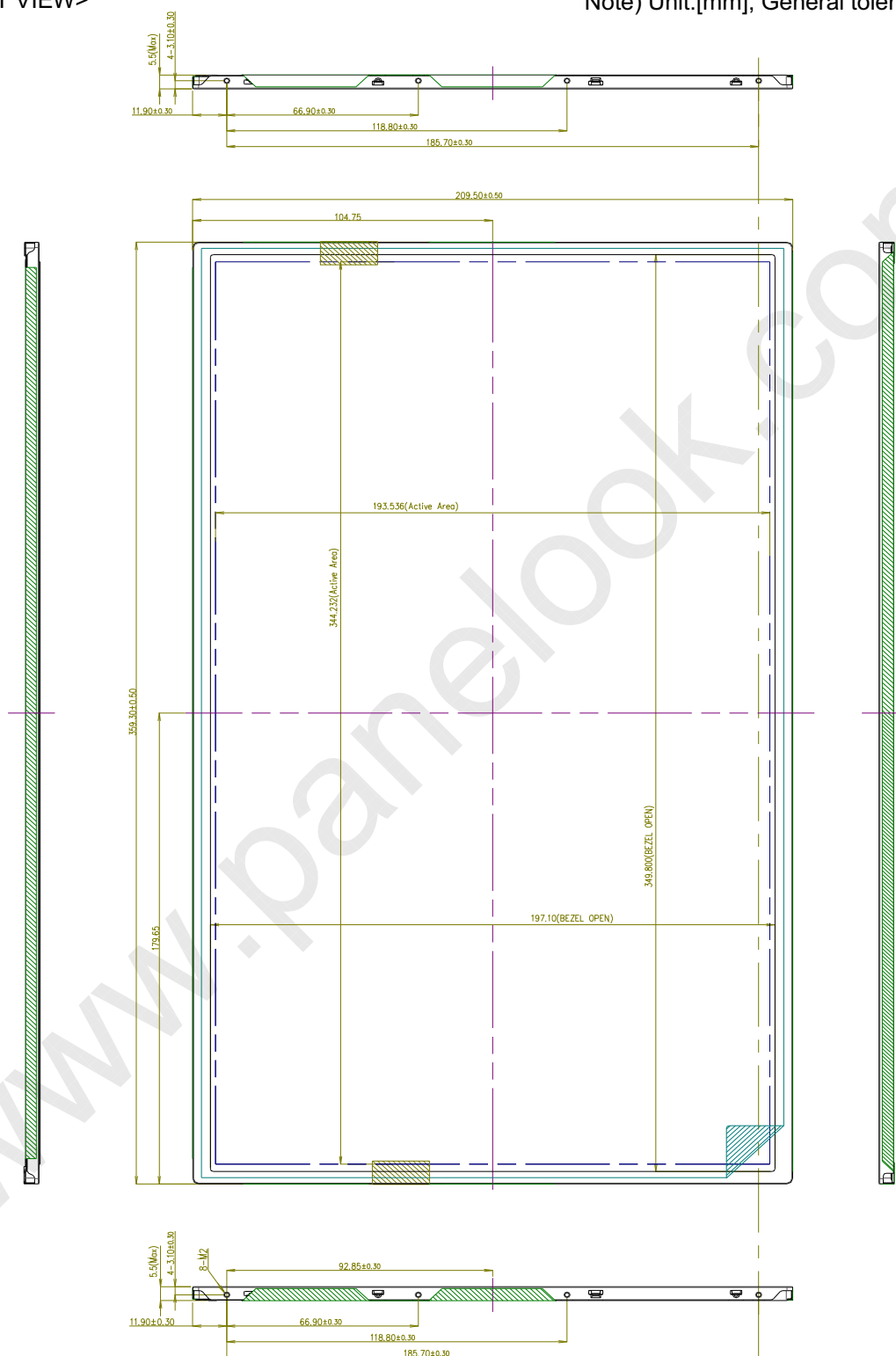


LP156WH2
Liquid Crystal Display

Product Specification

<FRONT VIEW>

Note) Unit:[mm], General tolerance: ± 0.5 mm



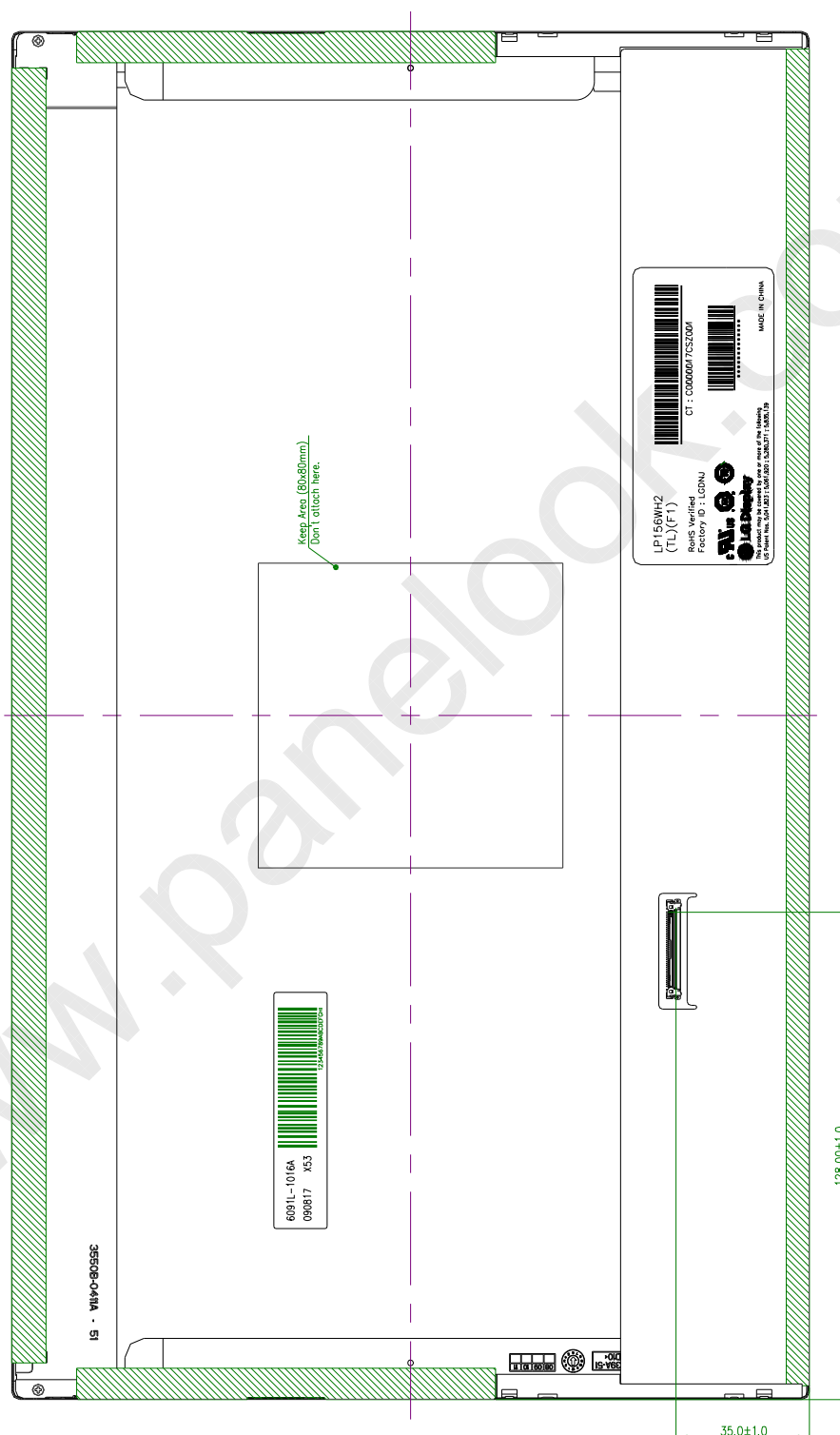


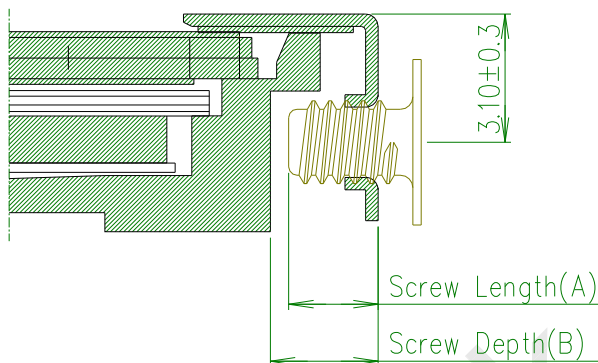
LP156WH2
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Product Specification

<REAR VIEW>

Note) Unit:[mm], General tolerance: ± 0.5 mm

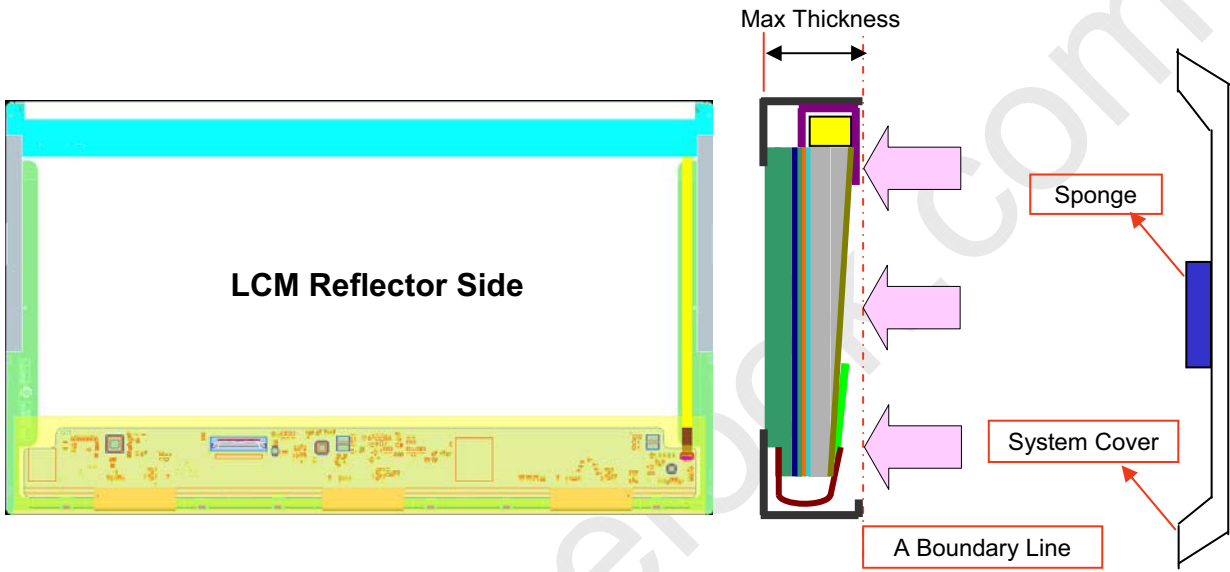
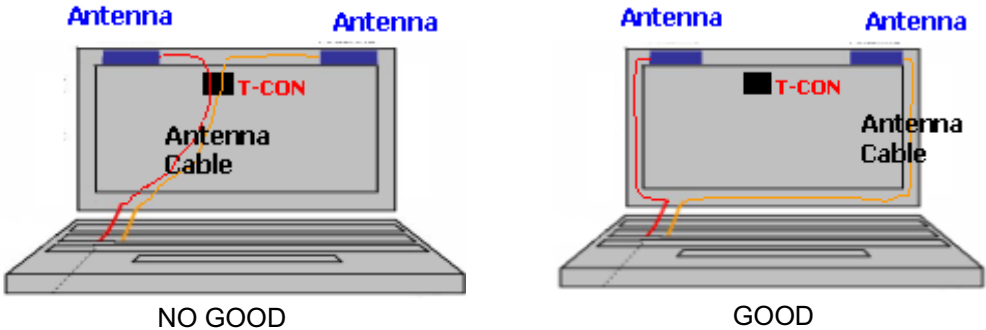


Product Specification**[DETAIL DESCRIPTION OF SIDE MOUNTING SCREW]**

- *Mounting Screw Length (A)
= 2.0(Min) / 2.5(Max)
- *Mounting Screw Hole Depth (B)
= 2.5(Min)
- *Mounting Hole Location : 3.10(typ.)
- *Torque : 2.0 kgf.cm(Max)
(Measurement gauge : torque meter)

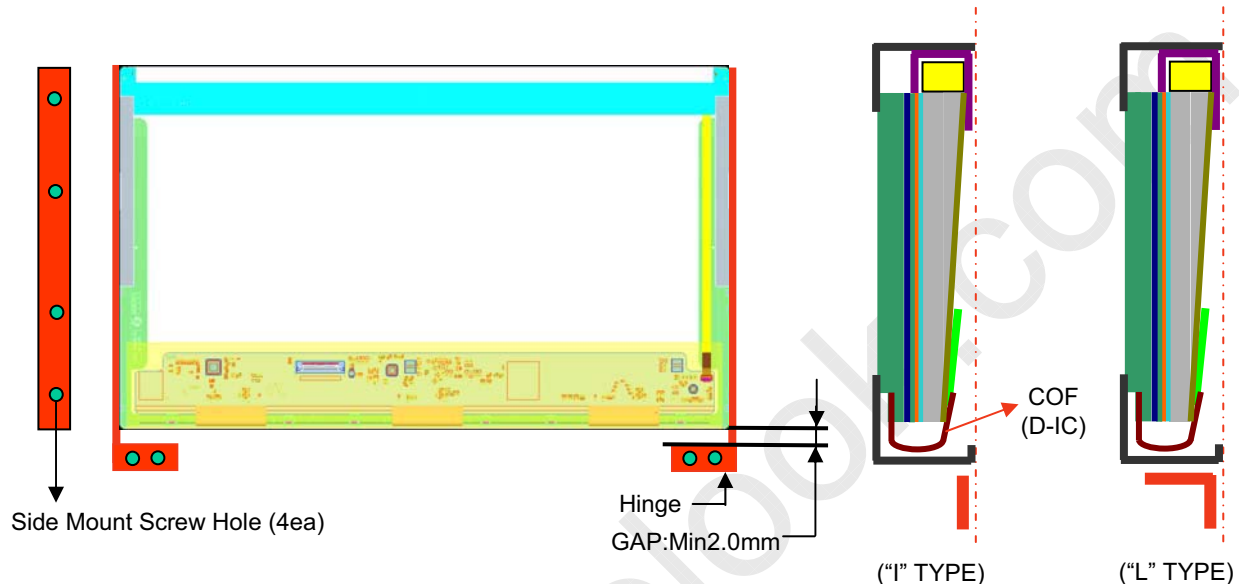
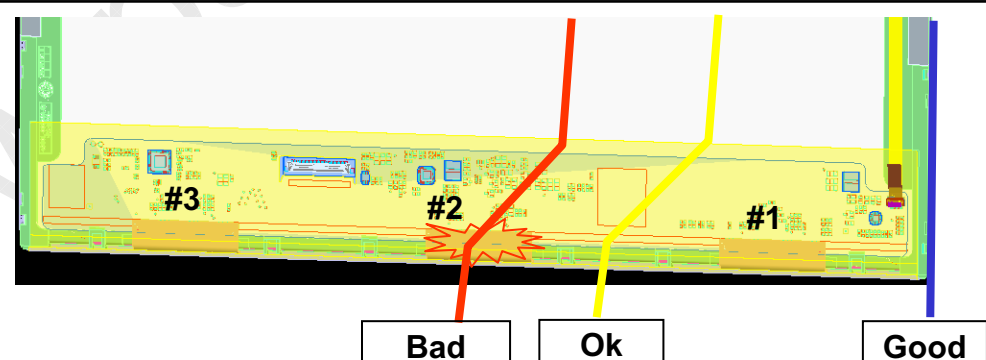
Notes : 1. Screw plated through the method of non-electrolytic nickel plating is preferred to reduce possibility that results in vertical and/or horizontal line defect due to the conductive particles from screw surface.

LGD Proposal for system cover design.(Appendix)


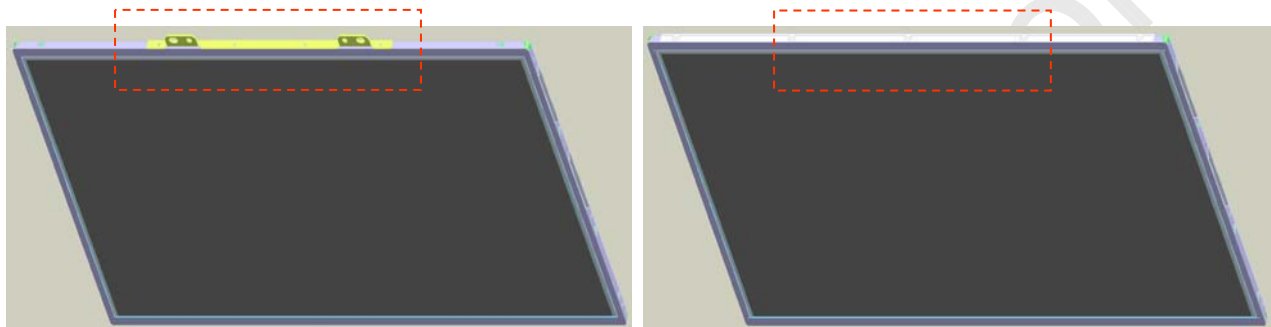
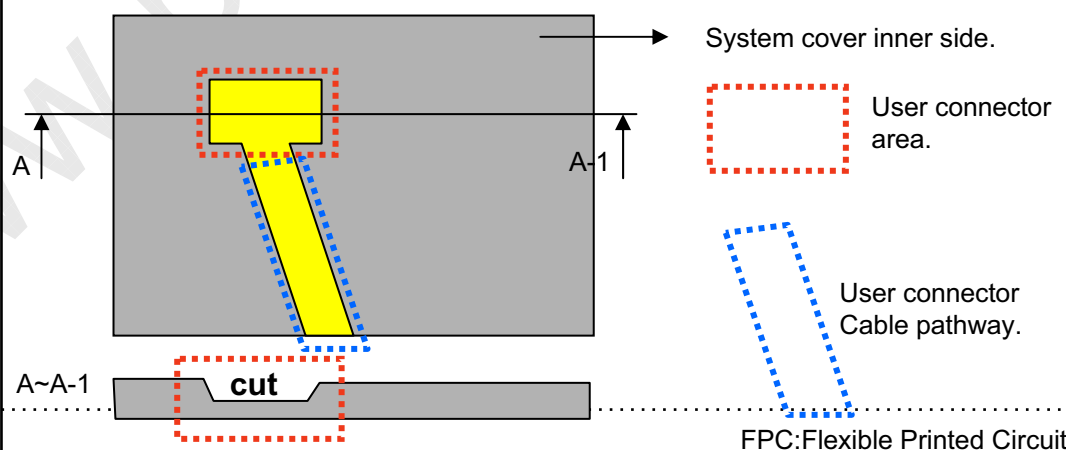
| | | |
|---|--|--|
| 1 | Gap check for securing the enough gap between LCM and System cover. | |
|  | | |
| Define | 1.Rear side of LCM is sensitive against external stress,and previous check about interference is highly needed. 2.In case there is something from system cover comes into the boundary above,mechanical interference may cause the FOS defects. (Eg: Ripple, White spot..) | |
| 2 | Check if antenna cable is sufficiently apart from T-CON of LCD Module. | |
| Define |  | |
| | 1.If system antenna is overlapped with T-CON,it might be cause the noise. | |

Product Specification

LGD Proposal for system cover design.

| | | |
|--|--|--|
| 3 | Gap check for securing the enough gap between LCM and System hinge. | |
|  <p>Side Mount Screw Hole (4ea)</p> <p>Hinge GAP: Min2.0mm</p> <p>COF (D-IC)</p> <p>("I" TYPE) ("L" TYPE)</p> | | |
| Define | 1. At least 2.0mm of gap needs to be secured to prevent the shock related defects. 2. "L" type of hinge is recommended than "I" type under shock test. | |
| 4 | Checking the path of the System wire. | |
|  <p>#3 #2 #1</p> <p>Bad Ok Good</p> | | |
| Define | 1. COF area needs to be handled with care. 2. GOOD → Wire path design to system side. OK → Wire path is located between COFs. BAD → Wire path overlapped with COF area. | |

LGD Proposal for system cover design.

| | | |
|--|---|--|
| 5 | Using a bracket on the top of LCM is not recommended. | |
| <div> bracket</div> <div><div>With bracketWithout bracket</div></div> | | |
| Define | 1.Condition without bracket is good for mechanical noise,and can minimize the light leakage from deformation of bracket. 2.The results shows that there is no difference between the condition with or without bracket. | |
| 6 | Securing additional gap on CNT area.. | |
| | <div><p>System cover inner side.</p><p>User connector area.</p><p>User connector Cable pathway.</p><p>cut</p><p>A~A-1</p><p>FPC:Flexible Printed Circuit.</p></div> | |
| Define | 1.CNT area is specially sensitive against external stress,and additional gap by cutting on system cover will be helpful on removing the Ripple. 2.Using a thinner CNT will be better. (eg: FPC type) | |
| Ver. 0.0 | | |
| Aug. 18, 2009 | | |
| 22 / 30 | | |

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Product Specification

6. Reliability

Environment test condition

| No. | Test Item | Conditions |
|-----|---|--|
| 1 | High temperature storage test | Ta= 60°C, 240h |
| 2 | Low temperature storage test | Ta= -20°C, 240h |
| 3 | High temperature operation test | Ta= 50°C, 50%RH, 240h |
| 4 | Low temperature operation test | Ta= 0°C, 240h |
| 5 | Vibration test (non-operating) | Sine wave, 10 ~ 500 ~ 10Hz, 1.5G, 0.37oct/min 3 axis, 1hour/axis |
| 6 | Shock test (non-operating) | Half sine wave, 180G, 2ms one shock of each six faces(I.e. run 180G 2ms for all six faces) |
| 7 | Altitude operating storage / shipment | 0 ~ 10,000 feet (3,048m) 24Hr 0 ~ 40,000 feet (12,192m) 24Hr |

{ Result Evaluation Criteria }

There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

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Product Specification

7. International Standards

7-1. Safety

- a) UL 60950-1:2003, First Edition, Underwriters Laboratories, Inc., Standard for Safety of Information Technology Equipment.
- b) CAN/CSA C22.2, No. 60950-1-03 1st Ed. April 1, 2003, Canadian Standards Association, Standard for Safety of Information Technology Equipment.
- c) EN 60950-1:2001, First Edition, European Committee for Electrotechnical Standardization(CENELEC) European Standard for Safety of Information Technology Equipment.

7-2. EMC

- a) ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHz to 40GHz." American National Standards Institute(ANSI), 1992
- b) C.I.S.P.R "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." International Special Committee on Radio Interference.
- c) EN 55022 "Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment." European Committee for Electrotechnical Standardization.(CENELEC), 1998 (Including A1: 2000)

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Product Specification

8. Packing

8-1. Designation of Lot Mark

a) Lot Mark

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

A,B,C : SIZE(INCH)
E : MONTHD : YEAR
F ~ M : SERIAL NO.

Note

1. YEAR

| | | | | | | | | | | |
|------|------|------|------|------|------|------|------|------|------|------|
| Year | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
| Mark | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 |

2. MONTH

| | | | | | | | | | | | | |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Mark | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C |

b) Location of Lot Mark

Serial No. is printed on the label. The label is attached to the backside of the LCD module.
This is subject to change without prior notice.

8-2. Packing Form

a) Package quantity in one box : 20 pcs

b) Box Size : 482 x 390 x 275

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Product Specification

9. PRECAUTIONS

Please pay attention to the followings when you use this TFT LCD module.

9-1. MOUNTING PRECAUTIONS

- (1) You must mount a module using holes arranged in four corners or four sides.
- (2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to resist external force.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- (6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth. (Some cosmetics are detrimental to the polarizer.)
- (7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- (8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (9) Do not open the case because inside circuits do not have sufficient strength.

9-2. OPERATING PRECAUTIONS

- (1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :
 $V = \pm 200\text{mV}$ (Over and under shoot voltage)
- (2) Response time depends on the temperature. (In lower temperature, it becomes longer.)
- (3) Brightness depends on the temperature. (In lower temperature, it becomes lower.)
And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.
- (4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- (5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.



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Product Specification

9-3. ELECTROSTATIC DISCHARGE CONTROL

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

9-4. PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

9-5. STORAGE

When storing modules as spares for a long time, the following precautions are necessary.

- (1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- (2) The polarizer surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.

9-6. HANDLING PRECAUTIONS FOR PROTECTION FILM

- (1) When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- (2) The protection film is attached to the polarizer with a small amount of glue. If some stress is applied to rub the protection film against the polarizer during the time you peel off the film, the glue is apt to remain on the polarizer.
Please carefully peel off the protection film without rubbing it against the polarizer.
- (3) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the polarizer after the protection film is peeled off.
- (4) You can remove the glue easily. When the glue remains on the polarizer surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.



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Product Specification

APPENDIX A. Enhanced Extended Display Identification Data (EEDID™) 1/3

| Byte# (decimal) | Byte# (HEX) | Field Name and Comments | Value (HEX) | Value (binary) | |
|--------------------|----------------|---|----------------|-------------------|---------------------------|
| 0 | 00 | Header | 0 0 | 0000 0000 | Header |
| 1 | 01 | Header | F F | 1111 1111 | |
| 2 | 02 | Header | F F | 1111 1111 | |
| 3 | 03 | Header | F F | 1111 1111 | |
| 4 | 04 | Header | F F | 1111 1111 | |
| 5 | 05 | Header | F F | 1111 1111 | |
| 6 | 06 | Header | F F | 1111 1111 | |
| 7 | 07 | Header | 0 0 | 0000 0000 | |
| 8 | 08 | EISA manufacturer code(3 Character ID) = LGD | 3 0 | 0011 0000 | Vender/ Product ID |
| 9 | 09 | Compressed ASCII | E 4 | 1110 0100 | |
| 10 | 0A | Product code = 021F | 1 F | 0001 1111 | |
| 11 | 0B | (Hex, LSB first) | 0 2 | 0000 0010 | |
| 12 | 0C | LCD module Serial No – Preferred but Optional ("0" if not used) | 0 0 | 0000 0000 | |
| 13 | 0D | LCD module Serial No – Preferred but Optional ("0" if not used) | 0 0 | 0000 0000 | |
| 14 | 0E | LCD module Serial No – Preferred but Optional ("0" if not used) | 0 0 | 0000 0000 | |
| 15 | 0F | LCD module Serial No – Preferred but Optional ("0" if not used) | 0 0 | 0000 0000 | |
| 16 | 10 | Week of Manufacture | 0 0 | 0000 0000 | EDID Version/ Revision |
| 17 | 11 | Year of Manufacture = 2009 | 1 3 | 0001 0011 | |
| 18 | 12 | EDID Structure version # = 1 | 0 1 | 0000 0001 | Display Parameter |
| 19 | 13 | EDID Revision # = 3 | 0 3 | 0000 0011 | |
| 20 | 14 | Video Input Definition = Digital I/P, non TMDS CRGB | 8 0 | 1000 0000 | Color Characteristic |
| 21 | 15 | Max H image size(cm)=34.4232cm(34) | 2 2 | 0010 0010 | |
| 22 | 16 | Max V image size(cm)=19.3536cm(19) | 1 3 | 0001 0011 | Established Timings |
| 23 | 17 | Display gamma =2.2 | 7 8 | 0111 1000 | |
| 24 | 18 | Feature support(DPMS) = Active off, RGB Color | 0 A | 0000 1010 | |
| 25 | 19 | Red/Green low Bits | A B | 1010 1011 | |
| 26 | 1A | Blue/White Low Bits | B 5 | 1011 0101 | |
| 27 | 1B | Red X Rx = 0.623 | 9 F | 1001 1111 | |
| 28 | 1C | Red Y Ry = 0.350 | 5 9 | 0101 1001 | |
| 29 | 1D | Green X Gx = 0.330 | 5 4 | 0101 0100 | Standard Timing ID |
| 30 | 1E | Green Y Gy = 0.589 | 9 6 | 1001 0110 | |
| 31 | 1F | Blue X Bx = 0.150 | 2 6 | 0010 0110 | |
| 32 | 20 | Blue Y By = 0.089 | 1 6 | 0001 0110 | |
| 33 | 21 | White X Wx= 0.313 | 5 0 | 0101 0000 | |
| 34 | 22 | White Y Wy= 0.329 | 5 4 | 0101 0100 | |
| 35 | 23 | Established Timing I = 00h(If not used) | 0 0 | 0000 0000 | |
| 36 | 24 | Established Timing II = 00h(If not used) | 0 0 | 0000 0000 | |
| 37 | 25 | Manufacturer's Timings = 00h(If not used) | 0 0 | 0000 0000 | Standard Timing ID |
| 38 | 26 | Standard Timing Identification 1 was not used | 0 1 | 0000 0001 | |
| 39 | 27 | Standard Timing Identification 1 was not used | 0 1 | 0000 0001 | |
| 40 | 28 | Standard Timing Identification 2 was not used | 0 1 | 0000 0001 | |
| 41 | 29 | Standard Timing Identification 2 was not used | 0 1 | 0000 0001 | |
| 42 | 2A | Standard Timing Identification 3 was not used | 0 1 | 0000 0001 | |
| 43 | 2B | Standard Timing Identification 3 was not used | 0 1 | 0000 0001 | |
| 44 | 2C | Standard Timing Identification 4 was not used | 0 1 | 0000 0001 | |
| 45 | 2D | Standard Timing Identification 4 was not used | 0 1 | 0000 0001 | |
| 46 | 2E | Standard Timing Identification 5 was not used | 0 1 | 0000 0001 | |
| 47 | 2F | Standard Timing Identification 5 was not used | 0 1 | 0000 0001 | |
| 48 | 30 | Standard Timing Identification 6 was not used | 0 1 | 0000 0001 | |
| 49 | 31 | Standard Timing Identification 6 was not used | 0 1 | 0000 0001 | |
| 50 | 32 | Standard Timing Identification 7 was not used | 0 1 | 0000 0001 | |
| 51 | 33 | Standard Timing Identification 7 was not used | 0 1 | 0000 0001 | |
| 52 | 34 | Standard Timing Identification 8 was not used | 0 1 | 0000 0001 | |
| 53 | 35 | Standard Timing Identification 8 was not used | 0 1 | 0000 0001 | |



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Product Specification

APPENDIX A. Enhanced Extended Display Identification Data (EEDID™) 2/3

| Byte# (decimal) | Byte# (HEX) | Field Name and Comments | Value (HEX) | Value (binary) | |
|--------------------|----------------|--|----------------|-------------------|-----------------------------|
| 54 | 36 | 1366X768 @60Hz mode pixel clock (LSB) => 72.3MHz | 3 E | 0011 1110 | Timing Descriptor #1 |
| 55 | 37 | (Stored LSB first) | 1 C | 0001 1100 | |
| 56 | 38 | Horizontal Active = 1366 pixels (lower 8bits) | 5 6 | 0101 0110 | |
| 57 | 39 | Horizontal Blanking = 160 pixels (lower 8bits) | A 0 | 1010 0000 | |
| 58 | 3A | Horizontal Active : Horizontal Blanking (upper 4:4bits) | 5 0 | 0101 0000 | |
| 59 | 3B | Vertical Active = 768 lines (lower 8bits) | 0 0 | 0000 0000 | |
| 60 | 3C | Vertical Blanking = 22 lines (lower 8bits) | 1 6 | 0001 0110 | |
| 61 | 3D | Vertical Active : Vertical Blanking (upper 4:4bits) | 3 0 | 0011 0000 | |
| 62 | 3E | Horizontal Sync. Offset = 48 pixels | 3 0 | 0011 0000 | |
| 63 | 3F | Horizontal Sync Pulse Width = 32 pixels | 2 0 | 0010 0000 | |
| 64 | 40 | Vertical Sync Offset = 3 lines : Sync Width = 5 lines | 3 5 | 0011 0101 | |
| 65 | 41 | Horizontal Vertical Sync Offset/Width upper 2bits = 0 | 0 0 | 0000 0000 | |
| 66 | 42 | Horizontal Image Size = 344.232mm(344) | 5 8 | 0101 1000 | |
| 67 | 43 | Vertical Image Size = 193.536mm(194) | C 2 | 1100 0010 | |
| 68 | 44 | Horizontal & Vertical Image Size | 1 0 | 0001 0000 | |
| 69 | 45 | Horizontal Border = 0 | 0 0 | 0000 0000 | Timing Description #2 |
| 70 | 46 | Vertical Border = 0 | 0 0 | 0000 0000 | |
| 71 | 47 | Non-interlaced, Normal display, no stereo, Digital separate sync, H/V pol negatives | 1 9 | 0001 1001 | |
| 72 | 48 | Flag | 0 0 | 0000 0000 | |
| 73 | 49 | Flag | 0 0 | 0000 0000 | |
| 74 | 4A | Flag | 0 0 | 0000 0000 | |
| 75 | 4B | Data Type Tag (Descriptor Defined by manufacturer) | 0 0 | 0000 0000 | |
| 76 | 4C | Flag | 0 0 | 0000 0000 | |
| 77 | 4D | Descriptor Defined by manufacturer | 0 0 | 0000 0000 | |
| 78 | 4E | Descriptor Defined by manufacturer | 0 0 | 0000 0000 | |
| 79 | 4F | Descriptor Defined by manufacturer | 0 0 | 0000 0000 | |
| 80 | 50 | Descriptor Defined by manufacturer | 0 0 | 0000 0000 | |
| 81 | 51 | Descriptor Defined by manufacturer | 0 0 | 0000 0000 | |
| 82 | 52 | Descriptor Defined by manufacturer | 0 0 | 0000 0000 | |
| 83 | 53 | Descriptor Defined by manufacturer | 0 0 | 0000 0000 | |
| 84 | 54 | Descriptor Defined by manufacturer | 0 0 | 0000 0000 | Timing Description #3 |
| 85 | 55 | Descriptor Defined by manufacturer | 0 0 | 0000 0000 | |
| 86 | 56 | Descriptor Defined by manufacturer | 0 0 | 0000 0000 | |
| 87 | 57 | Descriptor Defined by manufacturer | 0 0 | 0000 0000 | |
| 88 | 58 | Descriptor Defined by manufacturer | 0 0 | 0000 0000 | |
| 89 | 59 | Descriptor Defined by manufacturer | 0 0 | 0000 0000 | |
| 90 | 5A | Flag | 0 0 | 0000 0000 | |
| 91 | 5B | Flag | 0 0 | 0000 0000 | |
| 92 | 5C | Flag | 0 0 | 0000 0000 | |
| 93 | 5D | Data Type Tag (ASCII String) | F E | 1111 1110 | |
| 94 | 5E | Flag | 0 0 | 0000 0000 | |
| 95 | 5F | L | 4 C | 0100 1100 | |
| 96 | 60 | G | 4 7 | 0100 0111 | |
| 97 | 61 | | 2 0 | 0010 0000 | |
| 98 | 62 | D | 4 4 | 0100 0100 | |
| 99 | 63 | i | 6 9 | 0110 1001 | |
| 100 | 64 | s | 7 3 | 0111 0011 | |
| 101 | 65 | p | 7 0 | 0111 0000 | |
| 102 | 66 | l | 6 C | 0110 1100 | |
| 103 | 67 | a | 6 1 | 0110 0001 | |
| 104 | 68 | y | 7 9 | 0111 1001 | |
| 105 | 69 | Manufacturer P/N(If<13 char--> 0Ah, then terminate with ASC II code 0Ah,set remaining ch | 0 A | 0000 1010 | |
| 106 | 6A | Manufacturer P/N(If<13 char--> 0Ah, then terminate with ASC II code 0Ah,set remaining ch | 2 0 | 0010 0000 | |
| 107 | 6B | Manufacturer P/N(If<13 char--> 0Ah, then terminate with ASC II code 0Ah,set remaining ch | 2 0 | 0010 0000 | |

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Product Specification

APPENDIX A. Enhanced Extended Display Identification Data (EEDID™) 3/3

| Byte# (decimal) | Byte# (HEX) | Field Name and Comments | Value (HEX) | | Value (binary) | |
|--------------------|----------------|---|----------------|---|-------------------|-----------------------------|
| 108 | 6C | Flag | 0 | 0 | 0000 0000 | Timing Description #4 |
| 109 | 6D | Flag | 0 | 0 | 0000 0000 | |
| 110 | 6E | Flag | 0 | 0 | 0000 0000 | |
| 111 | 6F | Data Type Tag (Monitor Name, stored as ASCII) | F | C | 1111 1100 | |
| 112 | 70 | Flag | 0 | 0 | 0000 0000 | |
| 113 | 71 | L | 4 | C | 0100 1100 | |
| 114 | 72 | P | 5 | 0 | 0101 0000 | |
| 115 | 73 | 1 | 3 | 1 | 0011 0001 | |
| 116 | 74 | 5 | 3 | 5 | 0011 0101 | |
| 117 | 75 | 6 | 3 | 6 | 0011 0110 | |
| 118 | 76 | W | 5 | 7 | 0101 0111 | |
| 119 | 77 | H | 4 | 8 | 0100 1000 | |
| 120 | 78 | 2 | 3 | 2 | 0011 0010 | |
| 121 | 79 | - | 2 | D | 0010 1101 | |
| 122 | 7A | T | 5 | 4 | 0101 0100 | |
| 123 | 7B | L | 4 | C | 0100 1100 | |
| 124 | 7C | F | 4 | 6 | 0100 0110 | |
| 125 | 7D | 1 | 3 | 1 | 0011 0001 | |
| 126 | 7E | Extension flag = 00 | 0 | 0 | 0000 0000 | Extension Flag |
| 127 | 7F | Checksum | 8 | 9 | 1000 1001 | Checksum |